ABSTRACT FOR SPRING 1995 MRS MEETING

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Syposium Title: Materials Reliability in Microelectronics V

A FEM STUDY OF THE EFFECTS OF ELASTIC ANISOTROPY ON THE MICROSTRUCTURAL STABILITY AND RELIABILITY OF TEXTURED Cu FILMS AND INTERCONNECTS, T.P. Weihs, R.P. Vinci*, T.W. Barbee, Jr., and J.C. Bravman*, Chemistry and Materials Science Department, Lawrence Livermore National Laboratory, Livermore, CA, and *Department of Materials Science and Engineering, Stanford University, Stanford, CA.

The development of Cu metallizations for interconnects on integrated circuits and flat panel displays has stimulated a renewed interest in the microstructural stability of thin metallic films. Cu, unlike W and Al, is highly anisotropic elastically. Thermally induced stresses in Cu films with a strong (111) texture can be up to 2.3 times larger than those in Cu films with a strong (200) texture. As a result, the (111) growth texture can be unstable relative to the more compliant (200) texture. This paper examines the effect of crystallographic texture on the magnitude of thermal stresses and strain energy densities in Cu films and interconnects using finite element modeling. Two specific microstructural geometries are considered. The first is a single grain of Cu in a thin film of Cu. The single grain has one texture, (200) or (111), and the remainder of the film has the opposite crystallographic texture. Differences in thermal stresses, elastic relaxations, and strain energy densities for the two cases are used to predict the effect of elastic anisotropy on microstructural stability and grain growth in thin Cu films. The second geometry is a Cu interconnect that has either (111) or (200) texture and is encapsulated by a passivation layer. Differences in hydrostatic stresses, deviatoric stresses, and strain energy densities are used to assess the stability and reliability of (111) and (200) Cu interconnects.

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